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FERROUS METALLURGY IN THE NEW (FOURTH) FIVE-YEAR PLAN

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[This is a summary translation of a Russian book, Chernaya Metallurgiya v Novoy Pyatiletke (Ferrous Metallurgy in the New Five-Year Plan), published by the Academy of Sciences USSR. Large sections of this book are given to comparisons with iron and steel production in capitalist countries, especially in the US, and with explanations why metallurgy cannot expand as rapidly under capitalism as it does under socialism. These sections and others considered of little intelligence value have been omitted, and only those parts which contain information on the present position and future prospects of iron and steel production in the USSR appear here.]

Increase in Metal Production

The Five-Year Plan for the Reconstruction and Development of the National Economy in 1946-1950 is an essential factor in the development of ferrous metallurgy initiated by Comrade Stalin. Notwithstanding the necessity of reconstructing almost one half of the total capacity of the Soviet metallurgical industry destroyed during the German occupation, the level of metal output in the USSR will rise significantly in the course of the first postwar Five-Year Plan. In 1950, production of pig iron will amount to 19.5 million tons, steel 25.4 million tons, and rolled steel 17.8 million tons.

The rate of development of ferrous metallurgy during the Fourth Five-Year Plan greatly exceeds that of the First, Second, and Third Five-Year Plans. During the First Five-Year Plan the increase of pig iron amounted to 2.9 million tons and of steel 1.7 million tons. During the Second Five-Year Plan the corresponding increases were 8.3 and 11.8 million tons. The Third Five-Year Plan, which was disrupted by the war, called for an increase of 7.5 million tons in pig-iron production and 10.4 million tons in steel production. During the Fourth Five-Year Plan the increase in metal production will be even larger.

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The average annual increase of metal production during the First Five-Year Plan amounted to 0.7 million tons for pig iron and 0.4 million tons for steel; in the Second the corresponding increases amounted to 1.7 and 2.4 million tons. The Fourth Five-Year Plan calls for an annual increase of pig iron 1.2 times larger than in the Second and three times larger than in the First; the corresponding annual increase in steel production is to be 1.2 times and 7 times.

The following are expected to go into operation during the current five-year period: 45 blast furnaces, 165 open-hearth furnaces, 15 converters, 90 electric ovens, 104 rolling mills, and 63 coking batteries. Steel smelting will surpass pig-iron output, converter steel will reach twice the amount of prewar production, and production of high-quality steel, especially electrical steel, will be greatly increased.

Important shifts in the distribution of ferrous metallurgy are to take place during the Fourth Five-Year Plan. The postwar period will be characterized by the extensive shift of metallurgical enterprises to the East, the construction of new metal production centers, and the drawing in of Soviet borderlands into the mighty stream of industrialization.

Ural metallurgy is to increase its potential. The Novo-Tagil'sk Metallurgical Plant is nearing completion. Soon to go into operation are another blast furnace, one blooming mill, 4 rolling mills, 7 open-hearth furnaces and 2 Bessemer converters. The Chelyabinsk Metallurgical Plant, which is using pure Baykal ores, is also nearing completion. This plant will be the largest in the USSR producing high-quality metal. The following additions will be made during the fourth Five-Year Plan: 4 coking batteries, one blast furnace, 13 open-hearth furnaces, 5 electric ovens, 2 blooming mills, and 5 rolling mills. The Magnitogorsk Metallurgical Combine is undergoing large expansion and is becoming the largest metallurgical enterprise in the world. The Orsk-Khalilov Combine now under construction will use Khalilov chrome-nickel ores and will produce natural alloys. The first part of this plant will go into production during the current Five-Year Plan. A new electrical steel plant will be constructed in the East and the construction of four other metallurgical plants will continue in the Urals and in Siberia.

The Five-Year Plan provides for the construction of metallurgical plants in Kazakhstan, Uzbekistan, Transcaucasia, the Far East, and in the northwest USSR. The capacity of the plants now under construction in the South will be greatly enlarged.

The intensive development of metallurgy in the East radically changes the relative position of the various regions of the USSR in regard to the output of metal. Whereas before the Patriotic War the South was the basic metal-producing area of the USSR, the new Five-Year Plan is forcing this area gradually to relinquish its position, even though the output of metal in the South will increase during the Five-Year Plan. The share of the eastern areas in the total USSR production of steel in 1950 will change as follows in relation to 1940: pig iron from 29 to 44 percent; steel, from 34 to 51 percent; and rolled steel from 33 to 51 percent.

The plan provides for the construction in the Kazakh Republic of a pig-iron plant and a metallurgical plant with a complete production cycle, which will utilize the iron ore of the Ata-Su, Karkaralinsk, and Karsakpay deposits and Karaganda coal. Units of the first Uzbek metallurgical plant were already in production in 1946.

Share of Regions in the Production of Metal

(in % of the Plan)

Region	1939		1950	
	Pig Iron	Steel	Pig Iron	Steel
RSFSR	36.2	51.7	48.6	63.2
Including:				
Central	6.3	11.4	--	--
Volga Area	0.1	6.8	--	--
Northern Caucasus & Crimea	3.1	4.8	--	--
Urals	16.4	18.6	--	--
Western Siberia	10.3	10.0	--	--
Eastern Siberia	--	0.1	--	--
Ukrainian SSR	63.8	48.1	49.7	34.7
Georgian SSR	--	--	1.7	0.7
Belorussian SSR	--	0.02	--	--
Azerbaydzhan SSR	--	0.1	--	0.7
Kazakh SSR	--	--	--	0.3
Uzbek SSR	--	0.08	--	0.4
USSR total	100.0	100.0	100.0	100.0

A large metallurgical plant with a complete production cycle is under construction in the Georgian SSR. This plant will operate on Dashkesan ore and Tkvibuli and Tkvarcheli coal. A steel-pipe plant, to supply pipes to the oil industry, is under construction in Azerbaydzhan. These two plants will cover the basic metal requirements of the Transcaucasian republics.

The northwestern areas of the USSR, which possess a great number of large-scale machine-building enterprises, including the machine industry of Leningrad, are supplied at present with metals brought from the South, the Urals, and Siberia. The Fourth Five-Year Plan will witness the emergence of a metallurgical giant of the Northwest, which will utilize the ores of the Kola Peninsula, the coking coal of the Pechora Basin, the peat resources of the region, and the enormous amounts of scrap metal which are accumulating in this industrial area.

The geographical distribution of ferrous metallurgy during the Fourth Five-Year Plan should go a long way toward eliminating discrepancies between production and consumption of metal in the various parts of the USSR.

Utilization of Metal

The extensive building of industrial enterprises and the enormous development of railroad transport made it necessary for the USSR to concentrate on the output of heavy-gauge rolled metal. In 1939 rails, cover plates, blocks, tires, wheels, and axles constituted 21.2 percent of the entire rolled metal production (USA, 5.1 percent); beams, horizontal beams, and structural iron 37.7 percent (US, 24.3 percent); sheet metal (thick, medium, and thin; tin plate; and roofing tin) 19.4 percent (US, 47.2 percent).

During the new Five-Year Plan the utilization of metal will remain about the same as in 1940.

Assortment of Rolled Metal

(in %)

	1940	1950
Rails (railroad and streetcar)	9.5	9.5
Beams and horizontal beams	4.6	5.2
Including: medium	--	0.9
large	--	4.3
Structural iron	43.6	37.0
Including: small	--	13.3
medium	--	12.8
large	--	10.9
Fish plates	--*	3.6
Structural strips	1.9	1.6
Rolled wire	5.5	5.3
Sheet iron	19.2	19.5
Including: thin	5.9	7.3
medium and thick	13.3	12.2
General purpose iron	--*	1.5
Roofing tin and dip iron	1.5	1.4
Black sheet	0.7	0.8
Tires and wheels	2.1	2.3
Dynamo and transformer iron	--*	0.6
Hollow ingots	3.2	4.1
Axle bars and wrought iron	--*	1.7
Bars for various types of rolling [miscellaneous?]	8.2	5.9
	100.0	100.1

* Included in other types of rolled metal

Tin production is expected to increase greatly during the current Five-Year Plan; new technological processes, like continuous cold rolling, will be employed for its production. The metallurgical plant in Kazakhstan will be engaged mainly in the output of tin.

Iron-Ore Resources

Smelting of 50 million tons of pig iron a year will require the annual mining of 150 million tons of iron ore. To make this possible a number of important measures will have to be taken during the current Five-Year Plan.

The USSR has enormous natural resources which make possible a practically unlimited growth of ferrous metallurgy. The problem is to make these resources available to the metallurgical industry. One of the principal tasks of the Fourth Five-Year Plan is to speed up geological prospecting, especially in the eastern part of the USSR, in order to provide the needed raw materials for the rapidly expanding ferrous metallurgy.

According to 1939 estimates, USSR geological reserves of iron ore of all categories amounted to 10.9 billion tons, of which industrial ores (categories A and B) were estimated at 4.5 billion tons.

A number of deposits contain resources in excess of one billion tons. Thus, Krivoy Rog Basin ore reserves are estimated at more than 1.5 billion tons, with an iron content of 45-65 percent. The Krivoy Rog Basin is one of the most important suppliers of iron ore. Before the war, 60 percent of USSR iron ore came from this area. Enormous supplies of high-quality ores, the proximity of the Donets Basin coal, and the area's nearness to major consumers of metal, contributed in the past to the rapid development of ferrous metallurgy in the South. These factors open up even wider prospects for the future. The Fourth Five-Year Plan provides for the "reconstruction and further development of the Krivoy Rog iron-ore basin." There can be no doubt that a vastly expanded

metallurgy in the South will play its part in realizing Stalin's plan of smelting 50 million tons of pig iron.

The resources of the Krivoy Rog Basin are not limited to the availability of high-iron-content ores. The basin also contains enormous reserves of iron quartzite (estimated at more than 50 billion tons) with an iron content of 35-40 percent.

In addition to Krivoy Rog, the South has another important iron-ore deposit, the Kerch iron-ore mines, whose geological resources are placed at 2.7 billion tons, including 1.6 billion tons of industrial ores. The ores of this basin are complex in character, containing in addition to iron ore (30-40 percent), phosphorus, vanadium, and manganese. The character of the Kerch ores determines the direction in which they can be used metallurgically. They can be used as the basis for the production of Thomas-process phosphorous cast iron.

Before the war, the Kerch ores were not used to any great extent. Yet their utilization would be a fact of great economic significance: large iron-ore deposits would be used industrially, phosphoric slag could be obtained for use as fertilizer, and vanadium slag extracted for the processing of vanadium.

New iron-ore deposits will have to be found in the Far East and in Siberia. The capacity of the mines at Gornaya Shoriya (Western Siberia) will increase by 2 million tons in 1950. This will decrease to a considerable extent the long hauls of the Magnitogorsk ore to plants in Siberia, especially to the Kuznetsk Metallurgical Combine.

The metallurgical plant which is now under construction in Leningrad Rayon will utilize the rich iron-ore resources of the Kola Peninsula.

Beyond the current Five-Year Plan there is a plan to expand the ferrous metallurgy of the central USSR by utilizing the iron ore of the Kursk Magnetic Anomaly. These deposits have large iron-ore reserves (over 300 million tons) with an iron content of 58 percent. In addition to iron ore, the Kursk Magnetic Anomaly has enormous reserves of quartzite (about 200 billion tons) with an iron content of 35 percent.

The Kazakhstan iron-ore deposits are expected to undergo a considerable increase in their exploitation, especially the Khalilov chrome-nickel ores to be used in the production of natural-alloy metal. The titanomagnetites of the Urals will be used more extensively in the metallurgical process.

During the Fourth Five-Year Plan the reserves of industrial iron ore (categories A and B) will increase by 1,680 million tons and manganese reserves will increase by 110 million tons.

Output of Refractory Material

Increase in metal production requires a larger output of refractory material. It is estimated that 2.78 million tons of chamotte and 0.98 million tons of Dinas brick will be produced in 1950.

Reconstruction of Metallurgical Plants

The major objectives of the fourth Five-Year Plan in ferrous metallurgy are to attain the prewar production level and to increase that production by 35 percent. This means that the metallurgical capacity destroyed during the war has to be re-established.

The Germans destroyed 54 blast furnaces, 119 open-hearth furnaces, 101 rolling mills, 39 pipe-rolling mills. Three hundred and twelve steam boilers with a heating surface of 57,540 square meters were destroyed, and 527 boilers with a heating surface of 107,280 square meters were damaged; 45 steam turbines with a capacity of 254,350 kilowatts were destroyed, and 16 turbines with a

capacity 40,350 kilowatts were damaged; 53 steam-operated machines developing 51,250 hp were destroyed, and 29 steam-operated machines developing 42,025 hp were damaged. The Germans fully destroyed 12,768 electrical motors with a capacity of 402,130 kilowatts and damaged 3,564 motors with a capacity of 163,770 kilowatts. In addition, they destroyed a large number of metal-cutting machines and hoisting and transport equipment.

It is estimated that the reconstruction of the destroyed plants of the ferrous metallurgy will require about one million tons of rolled metal, more than one million tons of cement, more than one million tons of refractory material, more than 3 million cubic meters of timber, millions of square meters of glass, and about one billion construction bricks. Reconstruction work will require about 1.5 billion man-hours. The following will be re-established during the Fourth Five-Year Plan: 34 blast furnaces, 69 open-hearth furnaces, 14 converters, 16 electrical ovens, and dozens of rolling mills.

Physical Characteristics of Soviet Iron Ores

A large part of the ore mined in the USSR is less than 10 millimeters at the largest cross section of the lump. The fines of the Krivoy Rog ores amount to no less than 50 percent, while the Bessemer ores, richest in iron to be found in the Krivoy Rog, have a finer content of almost 80 percent. The Kerch ores are almost wholly made up of fines; and the Magnitogorsk ores also contain a large admixture of fines. The average fines content of ores for the whole USSR is 40 percent. Among the provisions of the Fourth Five-Year Plan is that 38 percent of the iron ore used in furnaces is to undergo agglomeration.

Utilization of Low-Grade Ores

High-grade ores, i.e., ores which require neither concentrating nor agglomeration, constitute only from 7-17 percent of the industrial ore reserves to be found in the principal USSR iron-ore deposits. By 1950, only about 40 percent of the iron ore required in ferrous metallurgy will be used without concentrating; the rest will have to undergo concentration or agglomeration. Among the important tasks of the Fourth Five-Year Plan is the development of better methods of concentrating low-grade ores. The existing methods are far from adequate. The loss of iron and manganese during concentration is too great. This is especially true in regard to manganese. The prewar methods of concentration yielded only 50-70 percent of manganese.

Preparing Coke for the Smelter

Most of the USSR coking coals have a high sulfur content. This is particularly true of the Donets coal, the sulfur content of which varies between 1.25 and 3 percent, with an average of 1.9 percent. The coke of Kuznetsk coal has a lower sulfur content. However, considering the fact that more than one half of USSR coke comes from Donets coal, the problem of reducing the sulfur content of coke acquires considerable significance. High ash content in coke is likewise a negative factor in the efficient operation of a smelter.

The Fourth Five-Year Plan provides for the construction of 271 coal-dressing plants with a capacity of 175 million tons a year.

Capacity of USSR Furnaces

The bulk of USSR pig iron is produced in ovens with a capacity of over 800 cubic meters. Before the war these ovens accounted for 63.6 percent of the pig-iron output, while ovens with a capacity of 1,000 cubic meters and over accounted for 30.9 percent of the output.

During the Fourth Five-Year Plan 44 blast furnaces with an average capacity of 824 cubic meters will either be newly constructed or reconstructed. Of this number, 24 will have a capacity of 1,000 cubic meters or over and will account for 70 percent of the output of the newly erected and reconstructed furnaces.

By the end of 1950 more than 70 percent of the annual pig-iron production will come from furnaces of 800 cubic meters and over; more than 50 percent of pig-iron output will come from furnaces of 1,000 cubic meters and over. The furnaces of Magnitogorsk, the Kuznetsk Combine, Zaporozhstal', the Krivoy Rog Plant, and Azovstal' will produce 40 percent of the total pig-iron output of the Soviet Union.

Open-Hearth Steel Production

About 80 percent of the steel produced in the USSR comes from open-hearth ovens. One of the principal factors in the increase of steel production is the enlargement of the steel smelters' capacities. This enlargement has outstripped all other countries, including the US. All metallurgical plants which were constructed during the Stalin Five-Year Plans have high-capacity open-hearth furnaces. The Magnitogorsk, Kuznetsk, Zaporozhstal', and Azovstal' Plants and the Dzerzhinskiy and Kirov Plants have open-hearth furnaces with a capacity of from 150 to 400 tons. In contrast to the practice prevailing in the US, Soviet builders do not limit themselves to ovens of 185-235 tons' capacity, but favor furnaces of larger dimensions. The latter involve smaller capital investment per ton of steel, greater fuel economy, and higher labor productivity.

It has hitherto been assumed that the smelting of high-quality steel and alloyed steel requires the use of small open-hearth furnaces. Experience during the Patriotic War has demonstrated the fallacy of this assumption. Alloyed steel and high-quality carbon steel were successfully produced in ovens of 185 tons, and even of 300 tons.

The average annual capacity of the 118 open-hearth furnaces which will enter production during the Fourth Five-Year Plan is estimated at 100,000 tons each. Furnaces with an annual capacity of 150,000 tons and over will constitute 70 percent of the total capacity of the new plants.

High-Quality Steel

Even before the Patriotic War, production of alloyed steel occupied a prominent place in the USSR. During the war, output of high-quality steel greatly increased. In the postwar period, the importance of alloyed steel will be even greater. It follows that the improvement in the quality of USSR-produced steel becomes an important national-economic problem. Of great importance in this connection is the development of methods for the production of alloyed steel which reduce the use of scarce alloyed elements to a minimum. The enormous resources of complex ores and the possibility of utilizing the alloyed elements contained in these ores create especially favorable conditions for the development of mass production of low-alloyed steel. The metallurgical processing of the complex ores contained in the Orsk-Khalilov deposits is to be increased greatly during the Fourth Five-Year Plan.

Rolled Steel

Before the war, only 60 percent of the steel ingots passed through the blooming and roughing mills. The rest of the steel came out in the form of small bars. Casting of small bars greatly diminishes the productivity of open-hearth furnaces. The Fourth Five-Year Plan provides for the installation of five new blooming mills and one roughing mill. The productive capacity of the roughing equipment in 1950 will amount to 19 million tons of ingot per annum.

Equipment for continuous rolling has been in operation in a number of Soviet steel plants, namely, Zaporozhstal' and the Krivoy Rog and Magnitogorsk Plants. During the current Five-Year Plan this highly efficient steel-rolling method will be greatly extended.

Before the war, electrically-operated rolling-mill machinery constituted 76.7 percent of the total USSR capacity. The aim of the current Five-Year Plan is to increase the percentage of electrically operated equipment still further.

Mechanization of Production

In 1940, 70 percent of the USSR pig-iron output was produced in highly mechanized plants. Steel production has not reached such a high degree of mechanization although it is considerably high. At the Dzerzhinskiy Plant's blast furnace No 8, which has a capacity of 930 cubic meters and is highly mechanized, only 113 workers were employed; of these only 40 attended directly to the furnace, while the rest performed auxiliary functions. Blast furnace No 5 at the same plant, which is not so well mechanized and has a capacity of only 425 cubic meters, employed as many as 305 workers.

In 1945 the Magnitogorsk and Kuznetsk Metallurgical Combines, which produced 4 million tons of pig iron, employed a total of 1,300 workers at 10 blast furnaces.

Mechanization of production in open-hearth furnaces likewise results in increased labor productivity. Thus, the nonmechanized open-hearth furnaces of the Verkhne-Isetsk Plant had 141 workers attending each of the four 41-ton-capacity ovens. On the other hand, the open-hearth furnaces of the Magnitogorsk Combine, which are fully mechanized and have a capacity of from 185 to 370 tons, in 1945 employed an average of 84 workers for each furnace.

Labor Productivity

Raising labor productivity is one of the principal tasks of the postwar Five-Year Plan. The average labor productivity before the war is illustrated in the following table:

Annual Production Per Worker (tons)

Plants	Cast Iron	Steel
Magnitogorsk Combine	2,840	1,168
Kuznetsk Combine	2,324	1,384
Krivoy Rog Plant	1,735	--
Zaporozhstal'	1,579	1,074
Azovstal'	1,642	654
Kirov Plant	2,102	523
Azerzhinskyy Plant	785	529
Petrovsky Plant	799	299
Krasnotorsk Plant	725	293
Ordzhonikidze Plant	707	400
Frunze Plant	636	403

The low per-capita production in many plants makes it imperative to take every possible measure to increase labor productivity in the postwar period.

Labor productivity can be raised (1) by increasing the parameter of metallurgical units without changing the number of workers in the plant, and (2) by mechanizing production and reducing the number of workers in the plant.

Another factor in increasing labor productivity is socialist competition and the extension of the Stakhanovite work methods.

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